

## **Equal distribution of disease, unequal distribution of cure: Using biological data to highlight health services inequities in sub-Saharan Africa**

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150 word abstract:

Syphilis is a sexually transmitted disease caused by a bacterium *Treponema pallidum*. If left untreated, it can lead to paralysis, aching bones, blindness, chest pain, heart failure and even death. In addition, syphilis facilitates the transmission of other sexually transmitted diseases including HIV. Treatment for syphilis is simple, effective, and inexpensive, yet in the developing world, the majority of those ever exposed to the bacteria continue to have active infections. We use biomarker data from the nationally-representative Demographic and Health Surveys in Madagascar, Uganda and Zambia to demonstrate that while distribution of disease is equal across a wealth gradient, the wealthiest are disproportionately likely to be treated for syphilis. In addition to describing these inequities, we analyze the sociodemographic and biological factors that are associated with syphilis infection. Using a comparative perspective, this analysis will highlight the role of public and health policy in mediating health outcomes for the poorest.

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Extended abstract:

### **Introduction:**

Syphilis is a sexually transmitted disease caused by a bacterium *Treponema pallidum*. If the disease is not diagnosed and treated it can damage many internal organs including brain, nerves, heart, blood vessels, liver, bones and joints leading to paralysis, aching bones, blindness, chest pain, heart failure and even death. In addition, syphilis facilitates the transmission of other sexually transmitted diseases including HIV. Treatment for syphilis is simple, effective, and inexpensive, yet in the developing world, the majority of those ever exposed to the bacteria continue to have active infections, particularly among the poor. Health systems are not adequately decentralized to reach more remote populations. As a result, health and economic productivity are compromised; lives are needlessly cut short.

With this analysis, we use data from three sub-Saharan African countries to describe the socioeconomic distribution of persons who have ever suffered from syphilis as well as the distribution of persons who suffer active infection, to highlight disparities in treatment for this disease. We also conduct multivariate analyses to discern risk factors for infection with *Treponema pallidum* to assist syphilis treatment programs in targeting their interventions.

### **Background:**

Syphilis is a treatable sexually transmitted disease that progresses through four stages: primary (a painless sore/chancere), secondary (rash especially on palms and soles and spread through blood circulation), latent (silent symptoms) or tertiary (organ damage) syphilis. During the early stages of disease, a traditional treatment of a single injection of benzathine penicillin or a course of commonly available oral antibiotics is required to reverse the progression of the disease and cure the person. However, treatment of syphilis does not make a person immune to syphilis and therefore knowledge on how to

prevent syphilis is equally important. In order to prevent syphilis from reoccurring in the treated person, it is imperative to treat the partner(s) of the infected person as well. Since the disease is transmissible during pregnancy with serious repercussions to the developing fetus including stillbirths, it is also important to test pregnant women.

Syphilis has been shown to be a gateway to other sexually transmitted infections (STIs) and HIV. Syphilis increases the risk of HIV infection by two- to five-fold. Observed co-infection with HIV is not surprising because risk factors related to sexual behavior are common to both the infections. It is also believed that with progression to secondary syphilis, more pronounced effects are observed with people infected with HIV, notably regarding their CD4 counts and viral load. By the same token, the viral load in HIV infected individuals coinfecting with syphilis is known to decrease upon treatment of the syphilis. Thus, in an era of epidemic HIV, treating syphilis solves not only the primary disease, but reduces the transmissibility of HIV and improves the survival status of those already infected with HIV. The most effective treatment for syphilis is an intramuscular injection of benzathine penicillin though oral antibiotics can also treat it.

## **Data and methods:**

### *Data*

The Demographic and Health Surveys (DHS) program included syphilis testing among men and women of reproductive ages in nationally-representative surveys in Madagascar, Uganda and Zambia. Madagascar sampled 4,980 households, Uganda sampled 8,870, and Zambia had a sample of 5,036.

Informed consent was obtained for all biological and survey data collection. Respondents who tested positive in the initial screening, as well as their sexual partners, were offered treatment for syphilis. A nurse or a medical person on the team treated all of the respondents who were tested positive on the field test. The treatment offered was a single injection of benzathine penicillin or an oral course of antibiotics such as doxycycline for men and non-pregnant women and erythromycin for pregnant women.

Rapid testing for syphilis and/or a rapid plasma regain (RPR) test was performed in the field. The test results were returned to the participants on either the same day or a day after the test was conducted. In addition, the blood specimens were taken to the laboratory for a second RPR test and a confirmatory test, treponemal pallidum haemagglutination assay (TPHA).

### *Methods*

We use bivariate methods to examine associations between syphilis infection and selected social, economic and demographic background characteristics. Specifically, we make use of the biological data's ability to identify cases of people who have ever been infected with syphilis (using RPR test results), as well the ability to identify cases of current infection (TPHA) to discern economically inequitable treatment patterns. We also conduct a more traditional risk factors analysis of the disease using logistic regression, with presence of infection as the dependent variable and factors associated with syphilis status including socio-economic status, social disparities, and knowledge of STIs among others.

## **Results:**

### *Prevalence of disease*

In Uganda, the disease does not carry the stigma as other STIs does and is viewed as a common illness. A prevalence of 3.4% was found in men and women ages 15-49. There are small differences in terms of

region (2.3% and 3.2% in urban and rural areas respectively). However, there is a lower prevalence in educated men and women. In addition, the infection also declines with increase in the socio-economic status. Use of condom in the past 12 months reduces the infection by half in men and women.

In Zambia, 7% of men (15-59) and women (15-49) have syphilis based on both the RPR and confirmatory test. Based on the screening test the prevalence of syphilis is 8.8%. Urban areas have higher prevalence (7.7%) compared to the rural areas (5.7%). Like Uganda, respondents with no education has higher prevalence of syphilis compared to respondents who have higher level of education.

In Madagascar, men and women ages 15-49 show a prevalence of 3.8%. Like Uganda, use of condom in the past 12 months reduced syphilis infection by half in men and women. There is also an association with lower syphilis prevalence among higher socio-economic status and higher education. However, unlike Uganda and Zambia, the prevalence of syphilis was higher in rural areas (6.8%) than urban areas (5.2%).

#### *Inequalities in distribution of disease and distribution of cure*

Preliminary results using data from Zambia indicate that while lifetime infection with syphilis is more prevalent among the wealthy, current infection is significantly lower among those in the wealthiest quintile of households. The results starkly indicate that, although overall treatment levels without reinfection are fairly low, it is those in the wealthiest quintile who have the best access to a cure.

More results will be forthcoming; Madagascar and Zambia will have a second round of data collection and we expect to be able to compare results over time as well as across countries.